(3) Remarks

This paper presents amended claims and arguments believed sufficient to overcome the prior art rejection made in the outstanding rejection.

In view of applicant's presentation of the amended claims and the following remarks that point out the patentable distinctions over the cited prior art, it is believed that all claims should now be allowed.

Claims 3, 5, 6 and 8-15 are now present in this application.

No claims are currently cancelled.

Amendments to the Specification

The specification has been amended at two points to correct minor typographical errors. Note that the first, to page 7, is purely gramatical in keeping with the examiner's comments. The second corrects the reference numeral " 72" for the " eccentricity" to – 52 – consistent with the multiple uses of the number, e.g., at page 7, line 11.

Specification Objection – 37 CFR 1.77(b)

The examiner objected to the specification for lacking suggested headings; however, applicant notes that the language of the rule is simply advisory and wishes to defer any amendment along these lines until allowable subject matter is indicated.

Applicant is willing to work with the examiner to provide section headings as appropriate prior to formal allowance.

Claim Amendments

Amendments have been made, centering on the examiner's **objections** and **rejections** for formal matters, and find full support in the specification. For example, taking new claim 13 as representative, the preamble finds support in the original claims and in the translation at

page 5, line 31 through page 6, line 3. The limitation of part a) of claim 13 is supported, for example, at page 7, lines 1-6. The limitation of part b) of claim 13 is supported, for example, at page 9, lines 8-9. The limitation of part c) of claim 13 is supported, for example, at page 9, lines 10-11. The limitation of part d) of claim 13 is supported, for example, at page 9, lines 12-14. The first portion of claim 15 (comparing said size and eccentricity of the propulsion force with stored standard values) is supported, for example, by original claim 1. The second part of claim 15 (to avoid a risk of damage of pipe elements) is supported, for example, at page 9, lines 14-17.

In addition, claim amendments have been made to better call attention to a major distinction between the process of the invention and the Richardson and Uemura references cited against independent claims 13 and 14.

While applicant believes that it should be clear from the original wording of the claims, it should now be unmistakable that the invention is far different than the prior art in calling for pushing and advancing a pipeline <u>assembled from a plurality of individual pipe elements</u>. The invention moves the entire pipeline, including all of its component pipe elements, by pushing at the most recently added pipe element. This creates great stresses that are simply not encountered by pressing on one element at a time as done in the worm-like movement of the Richardson and Uemura references.

Claim Rejections – 35 USC §103(a)

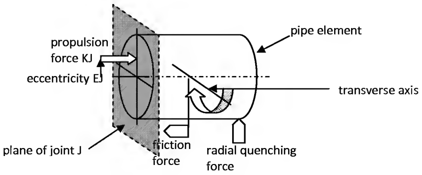
Claims 3, 5, 6 and 8 through 14 have rejected under 35 U.S.C. §103 as being unpatentable over US Patent No. 4,432,667 to Richardson in view of U. S. Patent No. 4,095,435 to Uemura. This rejection is respectfully traversed.

Applicant notes here the comments previously made against the Richardson reference. However, because the rejection is now also based on Uermura, these will not be repeated verbatim although they are still considered pertinent. Instead, applicant will try to explain with

several Figures and comments how the Richardson and Uemura references fail to meet principal distinguishing features of the invention. Importantly, the invention provides a method for determining the propulsion force, its eccentricity in relation to the neutral axis and/or the advance direction of a series of pipe elements, wherein a pressing device applies force to the assembly of pipe elements and the faces of fluid-filled expansion elements arranged in the joints between the pipe elements. The prior art moves one element at a time in worm-like motion and never moves the whole assembly – as does the invention – and, thus, never encounters the magnitude of stresses that the invention deals with and controls.

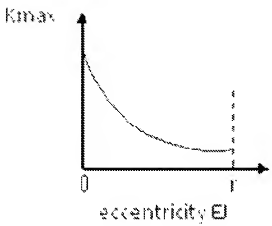
Reference is made to **Fig. A** below. If the exerted propulsion force KJ at the plane of joint J is eccentric and if there is a friction force (e.g. from the underground) acting opposite to the direction of the propulsion force KJ, the pipe element is urged into a clockwise rotation about the transverse axis. This rotation results in a radial quenching force squeezing the pipe. The pipe may break if the squeezing force is too big (KJ > Kmax). The higher the propulsion force KJ and the larger the eccentricity EJ, the higher is the radial quenching force. The larger the eccentricity EJ of a given propulsion force KJ the lower is the allowable maximum force Kmax (see diagram in Fig. B).

In a system where the pipe elements are advanced one by one (worm-like advancement) the propulsion force KJ corresponds to the applied force by the pressing ring in joint J. However, in a system, where all pipe elements are advanced at once, the propulsion force KJ at any joint does not correspond to the applied force by the pressing device.



Then, referring to **Fig. B**, in can be seen that the admissible propulsion force Kmax at a particular joint is highest, if there is no eccentricity. As the eccentricity EJ of the force increases, the admissible propulsion force quickly decreases. At an eccentricity EJ of r the admissible propulsion force Kmax may well be only 1/4 to 1/6 of the force at the center. According to the invention the actual propulsion force and its eccentricity are monitored and compared with the admissible propulsion force Kmax at a particular joint.

Fig. B



Going next to **Figs. C and D**, it can be seen that Kmax(Ji) indicates the permitted maximum propulsion force at the joint Ji (i = 1, 2, ...) for a particular course of the pipeline. If there is an eccentricity at joints J2 to J6, the permitted maximum propulsion force Kmax(J2), Kmax(J3) ,*etc.*, is lower at those joints (depending on the amount of eccentricity). K6(Ji) denotes the exerted (actual) propulsion force at the joints J1, J2 etc. if there are 6 pipe elements. K7(Ji) denotes the exerted propulsion force at the joints J1, J2 etc. if there are 7 pipe elements.

Due to a certain friction at each pipe element, the curves K6(Ji) and K7(Ji) decrease along the pipeline. So as the length of the pipeline increases, the propulsion force F1 of the pressing device in the pressing bay at the rear end has to increase. The above diagram shows a situation, where the exerted force at Joint J5 exceeds the permitted maximum propulsion force at this joint so that there is a risk of pipe breakage. According to the invention, this danger is

detected and an alarm is generated. This is possible because the system calculates the eccentricity and determines the corresponding permitted maximum propulsion force at the joint.

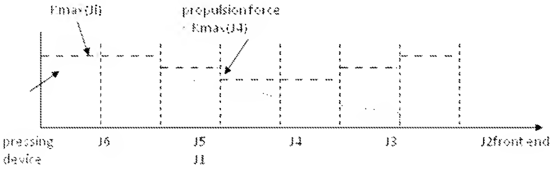


Fig. C

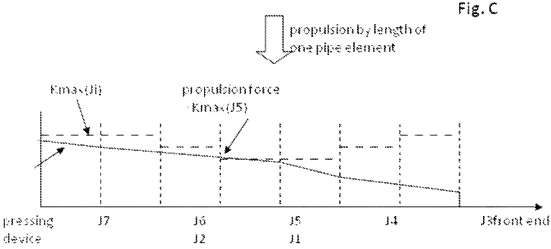


Fig. D

Fig. E helps to illustrate the fact that in the claimed invention, the rams for moving the whole pipeline are placed at the rear end of the pipeline in the pressing shaft or bay. The head of the pipeline advances synchronously with the expansion of the rams. Due to a certain friction at each pipe element, the effective propulsion forces K(J1), K(J2), K(J3) decrease along the pipeline. So as the length of the pipeline increases, the propulsion force F1 of the pressing device in the pressing bay at the rear end has to increase.

According to the invention, the valve for filling and discharging that hose that is used for pressure measurement is closed during propulsion of the pipe elements. Also the eccentricity of the propulsion force is measured in joint K(J3).

The system may register the pressure and eccentricity of the joints J1 to J3 and may dispatch an alarm, if the propulsion force (depending on the eccentricity) is too high.

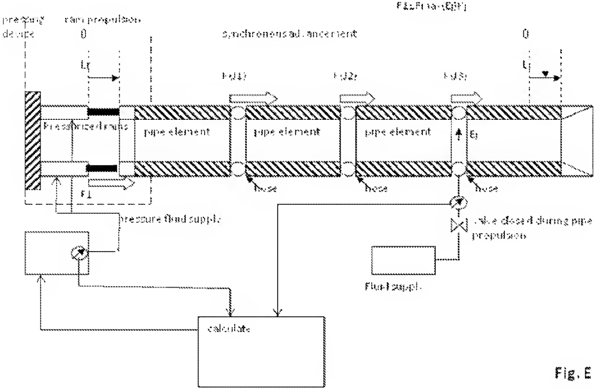


Fig. E

This is in sharp contrast with Richardson, which provides worm-like movement as can be seen from **Figs. 9 and 11** of the reference. It is clear that when the ram 60-3 is put under pressure, the hose 22-1 is compressed. That means the valve of the hose must be open for discharging the fluid. For performing the movement in the new direction, the hose is filled with fluid under pressure and the head is turning into the new direction.

FIG. 9

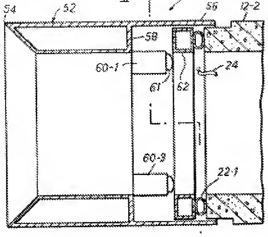
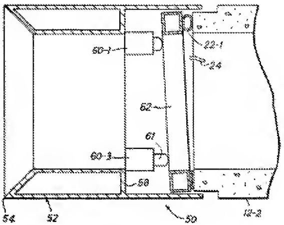


FIG. 11



Thus, the concept of worm-like movement of one element at a time is well illustrated by these figures and cannot be mistaken by one skilled in the art as the movement of the entire pipe assembly as claimed in the present application and illustrated in **Fig. E**, above.

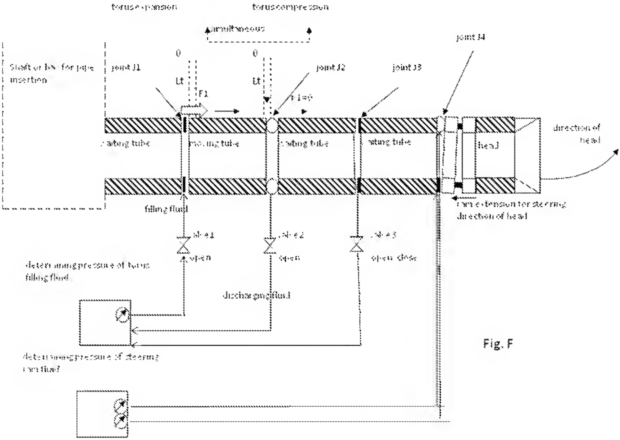


Fig. F

In **Fig. F**, the worm-like propulsion system of Richardson is shown to have two different pressing mechanisms. One pressing mechanism includes the hoses that are placed in the joints and that are alternatively and repeatedly filled and discharged to generate the worm-like forward movement. It is important that the torus on one end of the moving pipe element is filled (valve 1) while the torus at the other end of the same pipe element is simultaneously discharged (valve 2). The propulsion force acts on just one (moving) pipe element. Therefore, there is no need for a pressure control at the other joints.

The other pressing mechanism is a ram at the front end to change the direction of the head. In the normal course of action, a suitable fluid delivery device will fill the hose and control the pressure of the fluid in order to control the amount of movement of the one single moving pipe element. The pressure of the rams will have to be measured in order to control the ram extension and the corresponding change of the direction.

Importantly, that ram does not generate a propulsion force (see Fig. 11 of Richardson).

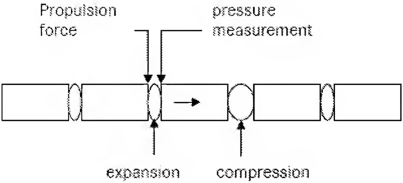
It is also important that according to the invention, the measurement of the propulsion force takes place in a device that is different from the device that generates the propulsion force. According to Richardson and Uemura, however, the pressure is (only) determined in the same device that generates the propulsion pressure.

And, in neither Richardson nor Uemura does the pressure advance the entire pipe assembly at once.

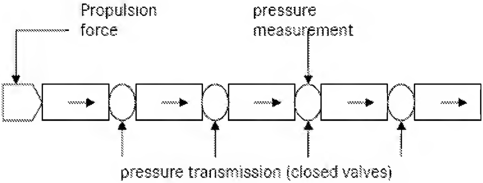
It cannot be understated that a very important difference between the invention and the prior art represented by Richardson and Uemura can be pinned down as follows:

In Richardson and Uemura, the worm-like propulsion system advances each pipe element individually and the pressure of the fluid is measured only in the pressing device that is

active at a particular point of time. As far as a pressure measurement is inherent, it takes place in the propulsion pressure device for the single pipe element.



For the invention, on the other hand, the claimed "all at once" propulsion system advances all pipe elements at the same time and the pressure of the fluid is measured in the pressure transmitting hose which is never a propulsion device.



These systems are very different and are not suggested by any combination of Robinson or Uemera. There is, in fact no recognition in the office action of this previously claimed and currently emphasized feature. Accordingly, the office action fails to set out a prima facie case of obviousness.

It is important to look at the prior art as a whole, as the person of ordinary skill in the art would look at it. The person skilled in the art would readily note that the patent to Uemura was granted in 1978 and the patent to Richardson issued as an improvement in 1984. The worm-like propulsion of a pipeline has already been known when Richardson filed his patent application. Richardson is therefore only an improvement of a known worm-like propulsion system. Generally speaking, the improvement made by Richardson resides in replacing the jacks between the pipe elements by inflatable hoses. Apart from this, Richardson is quite similar to Uemura but not to the claimed invention.

It is a characteristic feature of the perchaetial systems (having a worm-like advancement movement) that the pipe elements are advanced one by one. Therefore, each split or joint between pipe elements must be provided with a jack or expansion hose and must be activated in sequence. The advancement force acting on the moving pipe element corresponds directly to the force generated by the propulsion device.

Figs. 8b – 8e of Uemura show the worm-like propulsion method. There is always only one moving pipe element (6-2) between two waiting pipe elements (6-1, 6-3).

FIG.8b

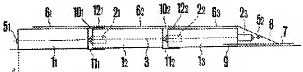


FIG.8c

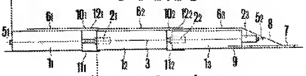


FIG.8d

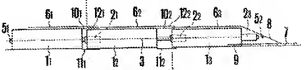
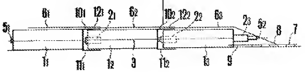


FIG.8e



Only one joint is expanding (10-2) and the other joint (10-1) of the moving pipe element is being compressed.

The above **Fig. F** explains the different function of the expansion hoses and of the steering jack of Richardson.

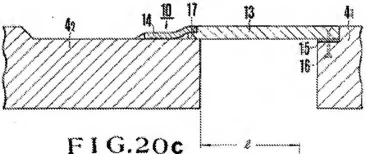
The disclosure of preferred aspects of Uemura (*e.g.*, see Claim 9) illustrates the difference in control. The pipe

elements are advanced one by one. For each pipe element there are propulsion jacks that advance just one pipe element. In order to be able to make a remote control, it is necessary to measure the distance between the moving pipe element (4.2) and the pipe element (4.1) that is in front. Determining the distance may be achieved by measuring the split between the pipe elements.

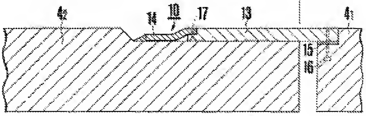
The jacks advancing element 4.2 are activated until the split has reduced to the required size. At the same time the shift measurements make sure that the advancement direction of the pipe element (4.2) does not produce a vertical or horizontal shift (misalignment). This is the type of control that is disclosed by Uemura. There is no limitation of a propulsion force depending on a calculated effective force and eccentricity at a pressing device way back at the rear end of the whole pipe line.

The split and shift measurements of the joint in Uemura is obviously different from the invention. The reason for these measurements is to determine when the single moving pipe element has arrived at the element that is waiting in front and whether there is an undesired horizontal or vertical shift (*i.e.*, mismatch) between the adjacent ends of the pipe elements.

F I G.20b



F I G.20c



These measurements are, however, not combined to calculate the permissible propulsion force. In fact,

there is no need to calculate the permissible propulsion force since this force directly corresponds to pressure applied by the force generating device that directly acts on the pipe element.

The invention advances the pipeline as a whole and has several advantages neither taught nor suggested by the references taken alone or in any possible combination.

The pressing device of the invention is acting on the rear pipe element and as a direct consequence of having transmission elements (hoses with closed valves, not allowing increase or decrease of the volume of fluid) the propulsion force is transmitted through the whole pipeline and simultaneous advancement of all pipe elements is effected.

The invention provides several advantages over the worm-like movement:

a) The pipeline can be advanced much quicker, since all elements advance simultaneously.

b) The speed of advancement is independent of the length of the pipeline.

c) One stroke of advancement corresponds to one length of a pipe element. This is much more than just one expansion width of one joint.

d) It is not necessary to provide pressing machinery or automatic valves for each of the pipe elements.

e) The pressing device is in the initial pressing bay which is easily accessible.

In order to achieve this faster advancement, the invention teaches a method of applying advancing pressure from the rear end and controlling the effective force and eccentricity in at least one (and typically in several) of the joints.

Therefore, it is possible to control the effective force at a joint that is distant from the pressure device. This makes it also possible to apply higher pressure at the rear end without losing control of the effective force at the front end or in between.

Neither Richardson nor Uemura disclose controlling the propulsion force depending on the eccentricity of the effective force.

It becomes apparent that one skilled in the art would ask why do Richardson and Uemure advance the pipes one by one, and that the answer is because they can easily control the propulsion force and avoid breaking of the (single) advancing pipe element as they use a pressure device for each single pipe element. So pressure of the pressing device directly corresponds to the effective propulsion force applied to the pipe element.

It would not be obvious to one skilled in the art to change this mode of operation of either Richardson or Uemura where this is central to their whole inventions and their improvements on the prior art. One skilled in the art would not find it obvious to change the whole nature of operation of the references.

The Office Action asserts that Richardson '667 discloses a method for determining/controlling the propulsion force on a plurality of pipe elements (12-n) to produce a longitudinal structure (10) in the earth. However, it does not. Richardson does not propel "a plurality of pipe elements" but only one single element at the time.

The Office Action also asserts that Richardson '667 discloses using a pressing device (i.e., hydraulic rams 60); however, to the contrary, the hydraulic ram 60 of Richardson is not a "pressing device" for "the propulsion force on a plurality of pipe elements". It is only a direction control device. As can be seen from Fig. 9 and 11, expanding the ram leads to compression of the hose 22-1. Therefore, the head 52 is not advanced by action of the ram 60. The propulsion is made by the single hose that activated to propel one single pipe element.

Next, the Office Action asserts that Richardson '667 discloses deformable fluid-filled expansion elements (22-n) arranged in joints of the pipe elements; however, this is incorrect. The hoses of Richardson are either being filled for propelling one single pipe element or are discharged. They are not kept "filled" during propulsion.

The Office Action further asserts that Richardson '667 discloses the longitudinal structure including a header piece (12-1) controlled with a front expansion element (22- 1); wherein the method includes the steps of filling the expansion elements with a pressure resistant fluid (col. 7, lines 32 through 35) and measuring the fluid pressure in the expansion element (col. 4 at lines 52 through 67); wherein the expansion elements have circular cross sections; wherein use of the expansion elements inherently controls the installation of the pipe elements and affects the quality of the installation. However, the invention does not fill the pressure transmitting hoses during propulsion.

And, the Office Action asserts that Uemura '435 discloses a method of advancing a plurality of construction units having joints there between, the method comprising the step of measuring deformation of the joints by three measurements (*i.e.*, those measurements taken by the split-measuring, vertical shift measuring and horizontal shift measuring instruments per Claim 9) and, inherently, calculating geometric data of an expansion plane of the joint from the three local measurements, the steps being useful for the remote control of the propulsion of the units. However, Uemura does not and measures the shift and split only at the joints of the single moving pipe element (to determine, when it has executed the desired advancement). Uemura does not measure shift and split at a joint further down the pipeline and does not calculate the eccentricity and effective propulsion force at a joint that is different from the joint where the pressing device is active.

It can also be seen that none of the problems solved by Uemura are relevant to either the present invention or Richardson. Moreover, Uemura requires linking members because of the type of movement, which is different from the invention and Richardson.

Yet further and importantly, the adaptation of Uemura's features of a linking member and the mode of movement would add complexity to Richardson while ignoring the improvement that reference provides to worm-like movement.

Applicant has endeavored to place the application in condition for allowance, but if for any reason the examiner sees need for formal changes, she is invited to call the undersigned. Accordingly, reconsideration and allowance of all claims are believed in order and are requested.

Applicant's attorney specifically requests the opportunity to have a personal interview with the examiner.

Respectfully submitted,

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